SANDIA NATIONAL LABORATORIES
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TITLE: CERTIFICATION OF TAPE EXTENSOMETER CALIBRATION FRAMES

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SNL Approval: Date: 3/11/94

SNL Safety Approval: CJ Mewhinney Date: 3-11-94

MOC Cognizant Department Manager Concurrence: Date: 3-16-94

MOC Manager of Industrial Safety: for LMC Date: 3/16/94

SNL QA Approval: pc Pat Charlet Date: 3/17/94

PURPOSE: The purpose of this document is to detail the procedures for certification of the SNL manufactured frames used to perform calibration checks on the Sinco model 518115 tape extensometer. Defined are any special conditions for WIPP organizations that must be met before the calibration frame (CF) is used in, but not limited to, routine inspections, gage calibration, data acquisition, and product acceptance.

RESPONSIBILITY: It is the responsibility of the person(s) performing this procedure to be familiar with this procedure, its references, and the equipment required for its performance. They are also responsible for assuring that pertinent standards and support equipment are in current certification. Certificates of traceability to the SNL Standards Laboratory are held by the site SNL QA representatives.

SAFETY: All work shall be done in compliance with the SNL Environmental Safety & Health (ES&H) Manual, the WIPP Safety Manual (WP 12-1), and any applicable Safe Operating Procedures (SOP's). The following safety concerns may also apply:

1. Access to the underground, if required, will be in accordance with current WIPP policies.

2. Ground control in underground work areas will be performed prior to start of work in accordance with current WIPP Policies.

3. Read any applicable MSDS sheets and follow guidelines mentioned prior to performing this procedure.

REFERENCES:

I. Procedure 393, Tape Extensometer and Extension Rod Calibration Check and Use (latest revision)

II. Procedure 451, Verification and Calibration of Outside Micrometers (latest revision)

III. Instructional booklet by The L. S. Starrett Company, Athol Massachusetts, "How to Read, Use and Care for Micrometers and Vernier Gages"

IV. Catalog No. 28, "Starrett Precision Tools, Gages and Saws," The L. S. Starrett Company, Athol, Massachusetts

V. Previous Calibration Records of Frame Calibration

DRAWINGS: None other than those in manuals.

FORMS: (latest revision)

I. Form 34, General Purpose Data

II. Form 267, Measurement Instrumentation Verification Log Sheet

III. Form 112, Gage Calibration Record

QA RECORDS:

I. Form 34, General Purpose Data

II. Form 267, Measurement Instrumentation Verification Log Sheet

III. Form 112, Gage Calibration Record

IV. Calibration Report

EQUIPMENT:

For Normal Calibration:

- Starrett Series 128 inside micrometer set with wrenches, combination head, and setting master
- Outside micrometer with 0" to 1" range
- Tape measure, sixteen foot
- Roll of sturdy twine, a material similar to that used with a line level
- (2) base post, swivel, and machinists C-clamp assemblies (for Surface frame)
- Spare 1/4" stainless steel bolts and sufficient tools to ensure their replacement
- Dusting brush and plastic sheeting

- Light lubricating oil
- Machinists Jacks (for underground frame)

If Point Deflection Check is Required:

- All items under Normal Calibration
- Starrett 711-T1 Last Word indicator kit
- Magnetic Dial Indicator Stand
- Sinco Tape Extensometer

PROCEDURE:

I. Calibration Preparation

A. Preparation of outside micrometer

1. Perform a calibration on a 0" to 1.0" range outside micrometer as per SNL procedure 451. Calibrate the micrometer per Section III. criteria, as stated within Procedure 451.

2. Store the calibrated micrometer in the same box with the Starrett 128 inside micrometer.

B. Calibration frame (CF) inspection and preparation

NOTE: An As-Found Calibration must be performed prior to any necessary corrective actions.

1. Inspect frame for anything that might effect calibration and take action to correct any problems. Annotate on form 34 any corrections/repairs made to the frame.

   a. If bolts are notched, bent, painted, or show signs of corrosion, perform an As-Found Calibration as documented in Section II. Then replace the damaged bolts and continue on with the procedure.

   b. If major defects are observed, such as a bent or cracked frame, or the frame needs to be moved due to salt creep or other problems, contact the SNL calibration lab supervisor.

2. If performing a certification on the CF in the underground, clean excess dust from frame and hooks.

3. On the surface frame only, attach the indicator base post, swivel and C-clamp assemblies (2) to the 1/4" - 20 holes previously tapped in the CF. The C-clamp assemblies should be stored in the Starrett 128 case.

C. Preparation of Series 128 inside micrometer

1. Remove combination head and setting master from case, and make sure the head is set to the exact size specified on the setting master.

   NOTE: BE SURE ALL MATING SURFACES ARE THOROUGHLY CLEAN.

   a. Set the micrometer thimble to read 1.000" (mid-range) and lock firmly in place with lock ring.

   b. Place combination head in setting master and position this assembly on a firm surface such that the micrometer measuring anvil is oriented up and the dial indicator points down.

   c. The micrometer end of the combination head should then be swept or rocked in two directions (fore and aft as well as from side to side) to obtain a MAXIMUM reading on the dial indicator.

   d. The small hand of the indicator must read zero while the large hand must read in accordance with the actual size marked on the setting master.

      (1) A master marked 10.0005" would cause the indicator small hand to read zero while the large hand should read PLUS .0005". A master marked 9.9995" would cause the small hand to read zero while the large hand should read MINUS .0005".

      (2) Note readings and all pertinent instrument information on a Measurement Instrumentation Verification Log Sheet, form 267.

   e. Should a correction be required, return the micrometer set to the SNL calibration lab for determination of its condition. The SNL calibration lab supervisor will decide whether the unit needs an adjustment, calibration at the SNL Standards Laboratory, or other action.

2. Check the mating surfaces and threads of the extension rods for rust and damage. Segregate and tag out any questionable items and ensure 15 feet of good rods are available for use. If not enough rods are available, see SNL calibration lab supervisor.

D. Preparation of Starrett dial indicator for deflection checks

1. Obtain the model 711-T1 Starrett Last Word dial indicator from the SNL calibration lab. This indicator has a resolution of 0.0001 inch.

2. Prepare and clean surface plate, the 0.100 through 0.108 inch gage blocks, the .2, .3, and .5 inch gage blocks, and the Starrett transfer gage.

3. Set transfer gage onto surface plate and mount dial indicator on transfer gage arm. Make sure indicator is level with surface plate and that transfer gage arm adjustment allows indicator pointer to get to within .5 inch of the surface plate. Tighten indicator and arm knobs securely. Also insure the interchangeable indicator pointer is tight.

4. Wring together the .5 and the .100 inch gage blocks to make a stack equalling .6 inch, and place on surface plate. Loosely stack the .2, .3, and .105 inch gage blocks and place them beside the stack with the .5 inch block.

   a. The stack with the .2 and .3 inch blocks, equalling .605 inch, allows the operator to support the indicator pointer while preparing another stack for subsequent readings. Therefore, wringing is not necessary. During calibration, this stack is used to push the wrung stack out from under pointer but is close enough in height to the wrung stack to prevent sudden shock to the indicator pointer.

   b. Handling gage blocks, even with gloved hands, tends to warm and expand them. Normal handling of a stack this size will not expand them beyond the limits of the resolution of this indicator, but it is measurable if interpolated. If a precision calibration is desired, always allow time for the blocks to cool before beginning measuring process.

5. Position pointer over stack with the .5 inch block, and using the transfer gage course and fine adjustments, contact gage blocks such that dial just begins to displace, but no more than .0005 inch. Position dial face so that pointer is above zero.

   a. Settle pointer by gently pounding the surface plate with the heel of your hand.

6. Initiate a calibration record, form 112, and note temperature, and appropriate serial numbers and expiration dates of the surface plate, gage blocks, temperature sensor, and dial indicator.

7. Note zero position indicator reading on calibration record.

8. Using the stack with the .2 and .3 inch blocks, push out from under pointer the stack containing the .5 inch block; in such a manner as the pointer slides from one to the other and is supported at all times.

   a. If pointer drops off the edge or the indicator is jarred in any way, repeat calibration.

9. Remove the smaller block from the stack with the .5 inch block and replace it with a block that is .001 inch thicker. Wring them together.

10. Using the stack with the .5 inch block, push out from under pointer the stack with the .2 and .3 inch blocks such that the pointer slides from one stack to the next.

11. Settle pointer as in step I. D. 5. a.

12. Read the amount of pointer displacement and note on form 112.

13. Repeat steps I. D. 8. through I. D. 12. until pointer has been displaced a total of .007 inch.

    a. In step I. D. 4., the blocks needed to do the .005" increment were used on the stack with the .2 and .3 inch blocks. When the need arises, remove the .105 inch block and replace it with the .108 inch block.

14. As a zero repeatability check, push out the stack with the .5 inch block with the stack containing the .2 and .3 inch blocks, replace the .107 inch block with .100 inch block, slide it back under pointer, and note indicator displacement on form 112.

15. Calibration is acceptable if all readings deviate no more than .0002 inch from actual displacement.

    a. If not, repeat calibration.

16. Place indicator in it's case and place with CF calibration equipment.

17. Lubricate gage blocks and transfer stand; store all equipment.

II. Calibration

A. Modifications to CF and measurement of bolt deflection

1. During the first CF calibration after 07/15/93, all eyebolts will be replaced with conventional 1/4 inch diameter hex head stainless steel bolts. This will be done because they will deflect less than most eyebolts, exact replacements will be easier to acquire if replacement is necessary, and elimination of the eyebolt hooking radius will improve tape extensometer calibration repeatability. Deflection of the hooking point with the spring loaded tape extensometer attached can be significant and any measurement point, especially if modifications are performed, must have a deflection check according to the following steps included in the calibration report. A before and after modification check shall be performed.

   NOTE: If no modifications are performed after 8/15/93, a deflection check is not necessary. Deflections have proven to be minimal, and for reporting purposes, numbers taken from previous reports can be used in future calibration reports as nominal deflections.

   a. Mount indicator and magnetic mount assembly to frame such that it will measure deflection as pulled toward tape extensometer as it is tensioned for a reading. On eyebolts, place pointer on outer radius opposite hooking point on inner radius. For hex head bolts, place pointer on one of the flats of the bolt head.

   b. Zero indicator and settle indicator by lightly pounding on CF with the heel of your hand. Repeat zeroing and settling process as necessary until indicator stays zeroed.

   c. Place tape extensometer on point to be checked being careful not to bump indicator pointer.

   d. Hook up other end of tape extensometer and take up slack as if taking normal reading.

   e. Read deflection of point on indicator dial and record in calibration notes for later mention in calibration report.

   f. Repeat II. A. 1. a. through II. A. 1. e. for all points of the CF.

B. Measurements between bolts with Starrett 128 inside micrometer

   1. Initiate a General Purpose Data, form 34, and organize it in the following manner:

a. The first column will be called "Location", and will indicate the pairs of bolts (A to B, A to C, A to D, and so on) between which measurements are to be taken.

b. Column two will be labeled "Chord Between bolts", and will contain the reading from the Model 128 inside micrometer as measured between the pairs of bolts.

NOTE: Bolt "A" will always be the one on the far left of the frame.

c. Column three will be labeled "Thickness of bolt A", which will contain the reading taken with the outside micrometer.

d. The fourth column will be labeled "Thickness of bolt at location", which will be the thickness of the bolt other than "A".

e. The fifth column will be labeled "Total" and will be a total of measurements on that row from columns two, three and four.

f. Record temperature at time of calibration in sixth column. The remaining column may be used for other pertinent test information and comments.

2. Assemble combination head and enough extension rods to measure between bolts A and B.

a. Make sure mating faces of extension rods are free of all dirt and damage to preserve the measurement integrity of the micrometer.

b. Use only insulating handles when assembling the micrometer and use only the wrenches provided by Starrett to lightly tighten each connection.

c. Assemble micrometer only on dry, flat, and clean surface. If working in the underground, the micrometer may need to be assembled on the floor of the drift. A piece of plastic sheeting shall be utilized to insulate the micrometer from dusty surfaces.

3. With the help of a second technician, lift micrometer and measure between the first pair of bolts.

a. While the other technician holds the extension rod anvil against bolt A, adjust micrometer thimble and close gap between micrometer anvil and the opposite bolt.

b. Ensure that the micrometer anvils are contacting the same portion of the bolt length that the tape extensometer would contact, while continuing to turn micrometer thimble until both hands of the indicator are on zero.

c. While getting close to bringing both hands to zero, you may want to move both anvils fore and aft to ensure smallest reading, thus insuring the highest points of the bolts. Hold micrometer anvils on these points when the reading is taken.

4. Log micrometer reading and bolt pair measured in appropriate columns of form 34.

5. Add appropriate number of extension rods to measure between next pair of bolts.

6. If the distance between bolts is over five feet; a base post, swivel, and machinists C-clamp assembly must be used on the surface frame to help support the micrometer and reduce the sag in the center of the instrument. Any sag will induce an error in the readings. Use machinist jacks on the under ground frame to reduce sag.

   a. To set up C-clamps or jacks, first tie a piece of twine or similar material between the bolts. The micrometer rods are 3/4" in diameter. Position C-clamps or jacks such that the string passes directly over and about 3/8" above the grove in the bottom of the C-clamp or top of the jack. Tighten swivel to hold base post and C-clamp rods in place.

   b. With the help of at least a second technician, place micrometer on supports set up in II. B. 6. a. being careful to prevent the micrometer from rolling off.

   c. For correct positioning, extension rods of various lengths may have to be interchanged to insure insulating handles do not contact measuring points, causing micrometer deflection.

7. Repeat II. B. 3. a. thru II. B. 3. c.

8. Take reading as detailed in II. B. 4.

9. Repeat sections II. B. 5., II. B. 6., II. B. 7., and log data as in II. B. 4. for all remaining pairs of bolts.

10. Disassemble micrometer, then clean and lightly oil all mating surfaces, and place all components back into the Starrett 128 case.

    NOTE: Use a lubricating oil that is a machine tool way oil or similar, do not use a light moisture dispersant like WD-40 or LPS-2.

11. Remove base post, swivel, and C-clamp assemblies and place in Starrett 128 case, and return case to it's designated storage area in the calibration laboratory.

C. Measurements taken with outside micrometer

1. Measure diameters of bolts with verified outside micrometer. For some bolts, a verified caliper will need to be used.

   a. The portion of the bolt diameter to be measured is from the same point contacted by the inside micrometer used in step II. B. 3. b. and along the axis.

      NOTE: If there is not enough clearance for micrometer and ball, use a verified caliper.

   b. If measuring eyebolts, place cup of the precision ball over the non-rotating micrometer anvil, and measure diameter of eyebolt with the ball being on the inside of the eye. The other micrometer anvil must contact the same spot on the outside diameter as when the measurement between the eyebolts was taken.

2. Log all bolt diameters and the precision ball diameter in appropriate column of form 34.

3. Lubricate micrometer or caliper and return to it's original case.

4. Turn in all completed forms to SNL calibration lab supervisor for approval.

III. Reporting and distribution of forms

A. The SNL calibration lab supervisor will ensure that a report summarizing the calibration events is prepared.

1. The report shall include a description of the frame, calibration date, expiration date, description of the test conditions, a summation of test data and results, and an uncertainty statement.

2. The SNL calibration lab supervisor will review and approve any reports prepared by a designee.

B. Completed and approved forms generated in the course of this procedure shall be attached to the report, and all shall then be submitted to the SNL QA Department.

C. A calibration sticker noting calibration date and expiration date shall be attached to the calibration frame.

D. A copy of the calibration report will be attached for reference purposes.

REVISION SUMMARY

To be completed by procedure's author before final revision is circulated for signatures.

I. Revisions made: Incorporated Red-line changes.

II. Personnel effected:

(Check appropriate ones)

MOC Craftsman		SNL JOB AREA	
Drilling	____	DAS General	____
Shop	____	DAS B49 Trailer	____
Mechanical	____	DAS Sheds	____
Electrical	____	DAS Equip. Cal. & Inv.	____
Gage	✓	Thermocouple	____
Cable/TC	____	Cables	____
U/G DAS	____	Drilling	____
Geotech	____	Gage Installation	____
		Gage Cal. & Removal	✓
		Plugging & Sealing	____
		Brine Transport	____
		QA	____
		General	____
		Principal Investigator	____
		Bin Leak Tester	____
		Permeability Testing	____

III. Retraining required:

(Circle One)

Read/Re-read procedure

Practical demonstration

Other (explain)

Signature of Procedure's Author D M. Schmaltz Date 3/1/94